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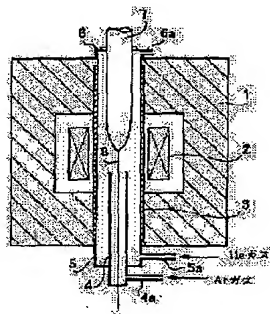
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(54) METHOD FOR DRAWING OPTICAL FIBER AND DEVICE THEREFOR

(57)Abstract:

PROBLEM TO BE SOLVED: To draw an optical fiber having concurrently provided with both sufficient transmission characteristics and sufficient strength.

SOLUTION: This method comprises: introducing an optical fiber preform 7 to the inside of a first furnace tube 3; heating and drawing an optical fiber 8 from the introduced optical fiber preform 7; and delivering the optical fiber 8 from the other end of the first furnace tube 3. In the method, a second furnace tube 4 is placed inside the first furnace tube 3 on the delivery side of the optical fiber 8 and the optical fiber 8 is drawn while introducing gaseous argon to the inside of the second furnace tube 4 to allow the gaseous argon to flow out toward the optical fiber preform 7 and concurrently, introducing gaseous helium to the outside of the second furnace tube 4 to allow the gaseous helium to flow out toward the optical fiber preform 7.



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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the wire-drawing equipment of the optical fiber of one gestalt of operation of this invention.

[Description of Notations]

- 1 Furnace Body
- 2 Heater
- 3 1st Work Tube
- 4 2nd Work Tube
- 4a Argon gas inlet
- 5 Lid
- 5a Gaseous helium inlet
- 6 Lid
- 6a Exhaust port
- 7 Optical Fiber Base Material
- 8 Optical Fiber

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the wire-drawing method of an optical fiber and wire-drawing equipment which heat an optical fiber base material and draw a line in an optical fiber.

[0002]

[Description of the Prior Art] The wire-drawing equipment of the conventional optical fiber has the structure where purge gas is passed, in order to discharge outside a furnace antioxiidizing of the heat insulator currently used in a wire-drawing furnace in the reactor core of a wire-drawing furnace, and the dust generated in the wire-drawing furnace.

[0003] Generally as this purge gas, argon gas, gaseous helium, nitrogen gas, etc. are used. The manufacturer of an optical fiber does comparison **** of change of the outer diameter of the optical fiber resulting from the turbulent flow generated in the cost price of gas, the transmission characteristic of an optical fiber, and the purge gas in a furnace, the exhaust air efficiency of the dust generated in a furnace, etc., and is choosing and using suitable purge gas.

[0004] Although it will become the order of nitrogen gas, argon gas, and gaseous helium if it carries out from the cost price of gas, outer-diameter control of an optical fiber is [being easy to generate a turbulent flow in a furnace originating a turbulent flow and tending to change the outer diameter of an optical fiber] difficult for nitrogen gas with the low coefficient of kinematic viscosity of gas, or argon gas. On the other hand, since a coefficient of kinematic viscosity is large and it is hard to generate a turbulent flow, outer-diameter change cannot take place easily, and gaseous helium becomes the order of gaseous helium, argon gas, and nitrogen gas in respect of the ease of using.

[0005] Moreover, since the intensity of an optical fiber is degraded, if the decline in the ventilation efficiency of a duct is considered from the field of the exhaust air efficiency of a duct, it is most effective to raise the rate of flow of purge gas, and it is easy a thing. Therefore, the gaseous helium to which the coefficient of kinematic viscosity of gas is high, and a turbulent flow cannot happen easily is the optimal.

[0006] There are what is determined before [the manufacture process of optical fiber base materials, such as a design of a refractive-index distribution,], and a thing resulting from the wire-drawing process looked at by the distributed value of a distributed shift fiber in the factor which affects the transmission characteristic of an optical fiber. In order for the heat history at the time of heating of an optical fiber base material and cooling of a fiber to have influenced greatly and to attain low loss-ization in a transmission characteristic as a factor in this wire-drawing process, argon gas with the annealing effect of a fiber is used in many cases.

[0007] From such a situation, transmission loss is used, changing suitably, using argon gas as purge gas in drawing of the low loss single mode optical fiber of less than 0.20dB /of km, as the proof loads for submarine installation etc. said that gaseous helium was used as purge gas in a long optical fiber by which 2% or more of high intensity optical fiber and the shipment length per articles exceed 50km.

[0008]

[Problem(s) to be Solved by the Invention] However, although it is advantageous in respect of transmission loss when argon gas is used in drawing of the conventional optical fiber, in respect of the intensity of an optical fiber, it is disadvantageous. Although it is advantageous in respect of the intensity of an optical fiber on the contrary on the other hand when gaseous helium is used, in respect of transmission loss, it is disadvantageous. Therefore, by the wire-drawing method of the conventional optical fiber using one kind of purge gas of argon gas or gaseous helium, the optical fiber with which transmission loss and intensity are compatible was not able to be obtained.

[0009] this invention was made in view of the above-mentioned situation, and aims at offering the optical fiber wire-drawing method and wire-drawing equipment which can draw a line in the optical fiber which was compatible in a transmission characteristic and intensity.

[0010]

[Means for Solving the Problem] In what the wire-drawing method of the optical fiber of this invention introduces an optical fiber base material into the interior from the end of the 1st work tube, carries out heating drawing of this, and sends out an optical fiber from the other end While being the interior of the 1st work tube of the above, preparing the 2nd work tube in the sending area of an optical fiber, introducing argon gas inside the 2nd work tube of the above and making it flow out towards the aforementioned optical fiber base material It is characterized by drawing a line in an optical fiber, introducing gaseous helium into the outside of the 2nd work tube of the above, and making it flow out towards the aforementioned optical fiber base material.

[0011] In the wire-drawing equipment of the optical fiber which the wire-drawing equipment of the optical fiber of this invention introduces an optical fiber base material into the interior from the end of the 1st work tube, carries out heating drawing of this, and sends out an optical fiber from the other end Are the interior of the 1st work tube of the above, and the 2nd work tube is prepared in the sending area of an optical fiber. The argon gas introduction means which introduces argon gas inside this 2nd work tube, and is made to flow out towards the aforementioned optical fiber base material is established. It is characterized by establishing the gaseous helium introduction means which introduces gaseous helium into the outside of the 2nd work tube of the above, and is made to flow out towards the aforementioned optical fiber base material.

[0012] Since transmission loss is low suppressed according to the annealing effect in argon gas since the inside of the 2nd work tube is passed, and it is made to pass gaseous helium on the outside of the 2nd work tube according to the wire-drawing method of the optical fiber of this invention, and wire-drawing equipment, the rate of flow can be raised because of the high coefficient of kinematic viscosity, the ventilation efficiency in a furnace can be raised, and intensity of an optical fiber can be made high.

[0013]

[Embodiments of the Invention] Hereafter, the wire-drawing method of an optical fiber and wire-drawing equipment concerning one gestalt of operation of this invention are explained based on an accompanying drawing.

[0014] The cylinder-like heater 2 is formed in the interior of a furnace body 1, the 1st work tube 3 made from carbon is formed inside a heater 2, lids 5 and 6 are attached in the upper and lower sides of the 1st work tube 3 among drawing, and, as for the wire-drawing equipment of the gestalt of this operation, the atmosphere of reactor core inside and outside is intercepted with these lids 5 and 6. The 2nd work tube 4 is attached in the lid 5 of the inside bottom of drawing in the state where it was inserted in the interior of the 1st work tube 3. Exhaust-port 6a is formed in the lid 6 of the inside top of drawing.

[0015] The 2nd work tube 4 is inserted to near the feeding-neck section of the optical fiber base material 7 inserted in the interior of the 1st work tube 3, and the optical fiber 8 on which a line was drawn inside this 2nd work tube 4 passes along it. The outer edge of the 2nd work tube 4 is blockaded, and argon gas inlet (it is equivalent to argon gas introduction means of this invention) 4a which introduces argon gas (Ar gas) inside the 2nd work tube 4, and is made to flow into the outer edge concerned towards the aforementioned optical fiber base material is prepared. Gaseous helium inlet (it is equivalent to gaseous helium introduction means of this invention) 5a which introduces gaseous helium (helium gas) into the

aforementioned lid 5 prepared in the 1st work-tube 3 bottom, and is made to flow into it towards the aforementioned optical fiber base material between the outside of the 2nd work tube 4 of the above and the inside of the 1st work tube 3 is prepared.

[0016] Next, the wire-drawing method which draws a line in an optical fiber is explained using the wire-drawing equipment of this optical fiber.

[0017] First, the optical fiber base material 7 is introduced into the interior from the end of the 1st work tube 3, and this is heated at a heater 2, a line is drawn in an optical fiber 8, and an optical fiber 8 is sent out from the other end of the 1st work tube 3.

[0018] Under the present circumstances, while introducing argon gas from argon gas inlet 4a inside the 2nd work tube 4, gaseous helium is introduced into the outside of the 2nd work tube 4 at high speed from gaseous helium inlet 5a. Argon gas and gaseous helium are discharged outside from exhaust port 6a through the side of an optical fiber 8 and the optical fiber base material 7 from near the soffit section in drawing of the optical fiber base material 7. The optical fiber 8 on which a line was drawn mainly by argon gas is annealed, and is ^{**}(ed) by the point [distortion] near 1070 degree C. On the other hand, the dust in a furnace is certainly discharged by the gaseous helium which mainly flows at high speed.

[0019] By being slowly cooled near a point [distortion], distortion which remains to an optical fiber 8 becomes small, and an optical fiber 8 can obtain the small optical fiber of transmission loss. Moreover, the gaseous helium which flows at high speed can raise the exhaust air efficiency of the dust in a furnace, and the optical fiber of high intensity can be obtained. Here, since the coefficient of kinematic viscosity is large, even if gaseous helium circulates the inside of a furnace at high speed, a turbulent flow cannot happen easily and changing the outer diameter of an optical fiber 8 does not occur, either.

[0020] Therefore, according to this wire-drawing method, transmission loss can manufacture the low loss single mode optical fiber to which the shipment length per one articles of optical fibers after 2% passage of proof loads exceeds 30km by km in less than 0.20dB /

[0021]

[Example] The wire-drawing method of the optical fiber of one example of this invention is explained below.

[0022] It is the same as that of the form of the aforementioned implementation to use argon gas and gaseous helium as purge gas. The flow rate of the argon gas introduced from argon gas inlet 4a was set to 5l. / min, and the flow rate of the gaseous helium introduced from gaseous helium inlet 5a was set to 40l. / min. Wire-drawing conditions performed 2100 degrees C for the internal temperature of the 1st work tube 3, and drew a line by two-layer covering of 500 mm/min and urethane acrylate material in wire-drawing speed. The transmission characteristic of the optical fiber 8 manufactured by this and 2% proof examination were performed. A test result is shown in Table 1. In addition, in order to compare the effect of the example of this invention, the optical fiber which serves as an example of comparison on condition that the following was manufactured, and the same examination was performed.

[0023] In the example 1 of comparison, while introducing argon gas by the flow rate of 5l. / min inside the 2nd work tube 4, argon gas was introduced by the flow rate of 40l. / min also like the outside of the 2nd work tube 4, and a line was drawn in the optical fiber on the same conditions as the above-mentioned example.

[0024] In the example 2 of comparison, while introducing gaseous helium by the flow rate of 5l. / min like the inside of the 2nd work tube 4, gaseous helium was introduced also into the outside of the 2nd work tube 4 by the flow rate of 40l. / min, and a line was drawn in the optical fiber on the same conditions as the above-mentioned example.

[0025]

[Table 1]

	伝送損失 (dB/km, at 1.55 μ m)	2%ブルーフ通過長 (km)
実施例	1.94	40.6
比較例1	1.96	24.0
比較例2	2.03	42.5

[0026] As shown in Table 1, as for the average passage length in a proof, transmission loss [in / $\lambda=1.55$ micrometers / in the optical fiber manufactured by this example] is about 40km 1.94dB / km // and 2%. although transmission loss does not not much have a change compared with the example 1 of comparison as for this -- the average passage length in 2% proof -- about twice -- it is large Although the average passage length in a proof seldom changes 2% compared with the example 2 of comparison, it turns out that transmission loss improves considerably. In addition, since the unit of transmission loss is dB/km, it serves as a big effect in a long optical fiber.

[0027]

[Effect of the Invention] As explained above, it is with the wire-drawing method of the optical fiber of this invention, and drawing equipment. Since transmission loss is low suppressed according to the annealing effect in argon gas since the inside of the 2nd work tube is passed, and it is made to pass gaseous helium on the outside of the 2nd work tube, the rate of flow can be raised because of the high coefficient of kinematic viscosity, the ventilation efficiency in a furnace can be raised, intensity of an optical fiber can be made high, and a line can be drawn in the optical fiber which was compatible in a transmission characteristic and intensity by this.

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CLAIMS

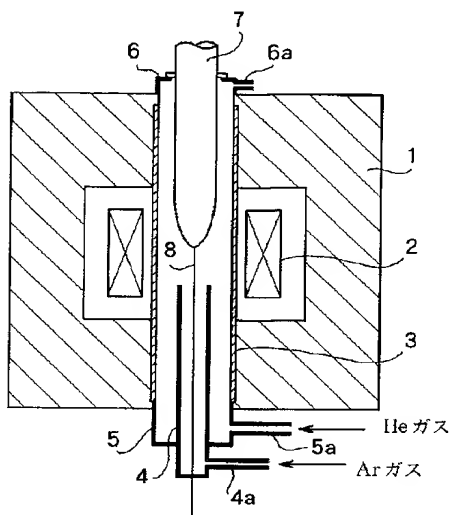
[Claim(s)]

[Claim 1] In the wire-drawing method of the optical fiber which introduces an optical fiber base material into the interior from the end of the 1st work tube, carries out heating drawing of this, and sends out an optical fiber from the other end While being the interior of the 1st work tube of the above, preparing the 2nd work tube in the sending area of an optical fiber, introducing argon gas inside the 2nd work tube of the above and making it flow out towards the aforementioned optical fiber base material The wire-drawing method of the optical fiber characterized by drawing a line in an optical fiber, introducing gaseous helium into the outside of the 2nd work tube of the above, and making it flow out towards the aforementioned optical fiber base material.

[Claim 2] In the wire-drawing equipment of the optical fiber which introduces an optical fiber base material into the interior from the end of the 1st work tube, carries out heating drawing of this, and sends out an optical fiber from the other end Are the interior of the 1st work tube of the above, and the 2nd work tube is prepared in the sending area of an optical fiber. The argon gas introduction means which introduces argon gas inside this 2nd work tube, and is made to flow out towards the aforementioned optical fiber base material is established. Wire-drawing equipment of the optical fiber characterized by establishing the gaseous helium introduction means which introduces gaseous helium into the outside of the 2nd work tube of the above, and is made to flow out towards the aforementioned optical fiber base material.

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Drawing selection [Representative drawing] ▾



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